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October 10, 1996



Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, DC 20554

Re: Ex parte presentation in RM-8811, ET Docket No. 95-183, RM-8553, PP Docket No. 93-253, ET Docket No. 94-124, RM-8308

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's rules and regulations, Motorola Satellite Communications, Inc. ("Motorola") hereby reports that an ex parte presentation was made on October 8, 1996 by representatives of Motorola to the following:

| | |
|---|---|
| Karl Kensinger | International Bureau |
| John Williams | Office of Plans and Policy |
| Ronald Netro | Wireless Telecommunications Bureau |
| Steve Sharkey | Office of Engineering and Technology |
| Michael Marcus | Office of Engineering and Technology |
| Joe Heaps | International Bureau |
| Harry Ng | International Bureau |

In that presentation, the Motorola representatives presented and discussed the attached document. They also discussed Motorola's position in the above-captioned proceedings, as that position has been set forth in Motorola's pleadings in these proceedings. Specifically, the Motorola representatives analyzed the spectrum needs of satellite systems in the frequencies implicated in these proceedings.

Three originals and three copies of this letter are being submitted for inclusion in the above-referenced dockets.

Sincerely,

Pantelis Michalopoulos
Attorney for Motorola Satellite
Communications, Inc.

Attachment

cc: Mr. Karl Kensinger
Mr. John Williams
Mr. Ronald Netro
Mr. Steve Sharkey
Mr. Michael Marcus
Mr. Joe Heaps
Mr. Harry Ng

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*Satellite Communications Division*

# The M-Star System

## A Global Network of Non-Geostationary Communications Satellites Providing Broadband Services in the 40 GHz Band

**Filed 4 September 1996 by:**

**Motorola Satellite Systems, Inc.**

# Agenda

- System Description
- Business Plan
- Spectrum Requirements
- Sharing Analysis - Fixed Systems
- Sharing With Other Systems
- Sharing Rules
- Summary

# M-Star System Description

- Non-GSO Global satellite system comprising 72 satellites.
- Real-time wide-band information transfer
  - ⇒ Voice, Data, Digital Video, and Audio.
  - ⇒ Covering protocols such as ISDN, Frame Relay, X.25, TCP/IP, ATM, FDDI, and OC-1.
- Data rates from 2.048 Mbps to 51.84 Mbps.

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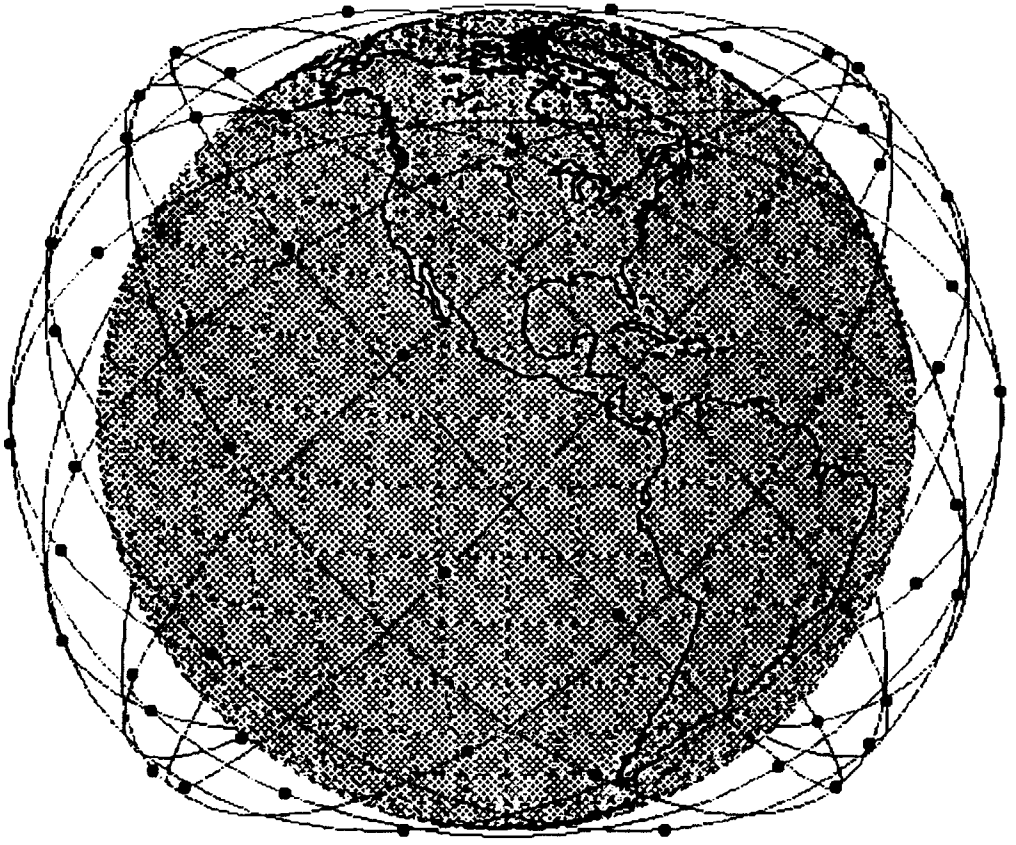
# M-Star



| | |
|---|---|
| Number of Planes: | 12 |
| Satellites per Plane: | 6 |
| Inclination: | 47° |
| Altitude: | 1350 km |
| Argument of Perigee: | 0° |
| Eccentricity: | 0.0013 |
| Plane Spacing at Equator: | 30° |
| Plane Phasing: | +25° |
| Minimum elevation Angle: | 22° |
| Orbit Period: | 6761 seconds |

# M-Star Communications

| Parameter Description | WAG/ E-1 Specification | HBR Specification |
|---|---|---|
| Modulation Format | QPSK | QPSK |
| Coding | Convolutional Concatenated With Reed Solomon | Convolutional Concatenated With Reed Solomon |
| Target Bit Error Rate | $10^{-6}$ | $10^{-9}$ |
| Data Rates (information) | 2.048 Mbps | 51.84 Mbps |
| Downlink Bandwidth | 3 GHz | 3 GHz |
| Uplink Bandwidth | 3 GHz | 3 GHz |
| Eb/ No requirement | 2.2 dB. | 2.7 dB |
| Ground Station RF Power Amplifier | up to 7.9 W for E-1 Terminals | up to 46.2 W for MTSO Terminals to Cell Site<br><br>up to 79.5 W for HB Terminals |
| Ground Terminal Aperture (m) | 0.66 | 1.5 |
| Ground Terminal Figure of Merit G/T | 19.3 dB/ K | 26.4 dB/ K |

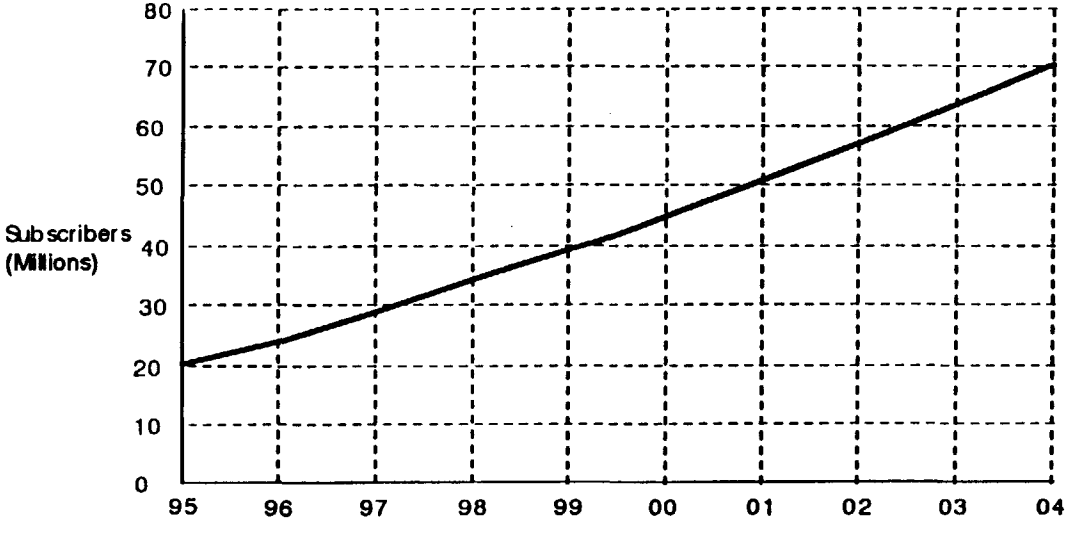
# Business Plan

**M-Star will provide**

- **Competitively priced regional and global communication**
- **Ready to use broadband infrastructure by 2000**
  - **⇒Lower total cost than global fiber networks**
  - **⇒Less time to build than a global fiber network**
- **Enhanced competition in telecommunication markets**

# Market & Demand for Services

- **Third generation wireless services will include several advanced forms of voice and data communications transmitted from pocket sized telephones, wireless facsimile machines and other portable devices**




The growth of wireless subscribers forecasted by the Yankee Group (Reference: "PCS: The Implementation Phase", the Yankee Group, February 1995).

# Market & Demand for Services

- M-Star provides for the interconnection between backhauls
- M-Star provides for LAN - LAN direct connections
- M-Star provides for small services connectivity or an aggregate of service providers (E-1)

# M-Star Spectrum Plan

- **Service Links:**
  - **37.5 - 40.5 GHz (Space-to-Earth)**
  - **47.2 - 50.2 GHz (Earth-to-Space)**
- **Inter-Satellite Links:**
  - **59.0 - 64.0 GHz**
- **TT&C Links will operate in the service link band**
  - ⇒ **Launch and emergency operations in FSS band below 18 GHz**

# M-Star Satellite Capacity

- **Traffic Capacity**
  - ⇒**The distribution of end users will create high peak demands on the system. These peak demands are a key determinant of the overall spectrum requirements.**
  - ⇒**High peak traffic demands are managed by the use of a LEO Constellation, a versatile satellite payload and an antenna designed to create relative small beam coverage areas in the satellite coverage footprint.**
  - ⇒**A single space vehicle will support as many as 1800 E-1 links and 16 OC-1 links.**

# M-Star Typical Spectrum Requirements

- Town & Small City
  - ⇒250 E-1 links/town
  - ⇒25 E-1 links/transponder
  - ⇒1 OC-1 link/town
  - ⇒90 MHz/transponder
  - ⇒990 MHz per town
- Large City
  - ⇒ 450 E-1 links/city
  - ⇒ 25 E-1 links/transponder
  - ⇒ 15 OC-1 links/city
  - ⇒ 90 MHz/transponder
  - ⇒ 2970 MHz/city

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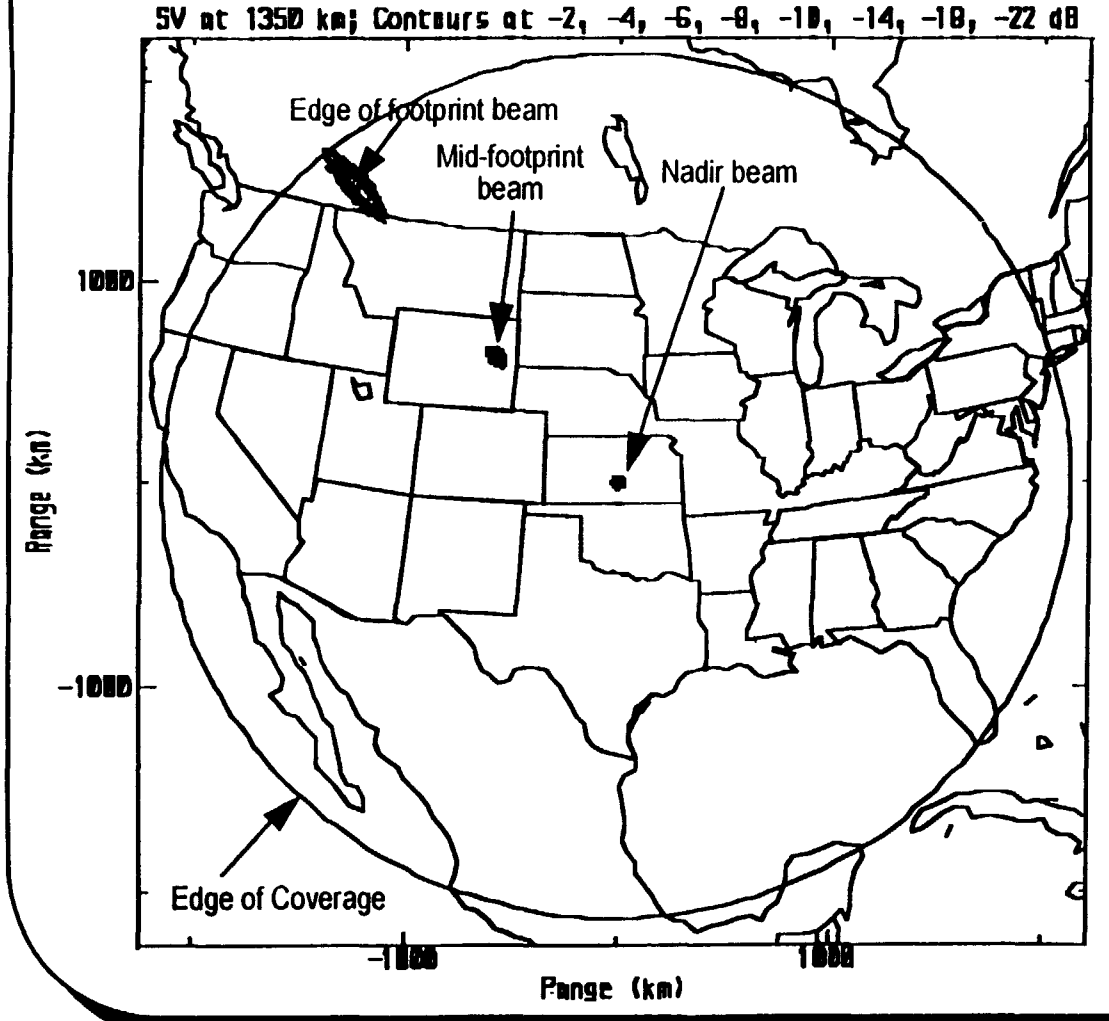
# M-Star Satellite Footprint




QPSK Modulation, Convolutional Coding concatenated with R/S

E1 Links

| | |
|---|---|
| BER | 10-6 |
| Eb/No | 2.2 dB |
| Rate | 2.048 Mbps |
| BW | 3 GHz |

Xmit Antenna 0.66 m 7.9 W

Rx Antenna G/T=19.3 dB/K

OC-1 Links

| | |
|---|---|
| BER | 10-9 |
| Eb/No | 2.7 dB |
| Rate | 51.84 Mbps |
| BW | 3 GHz |

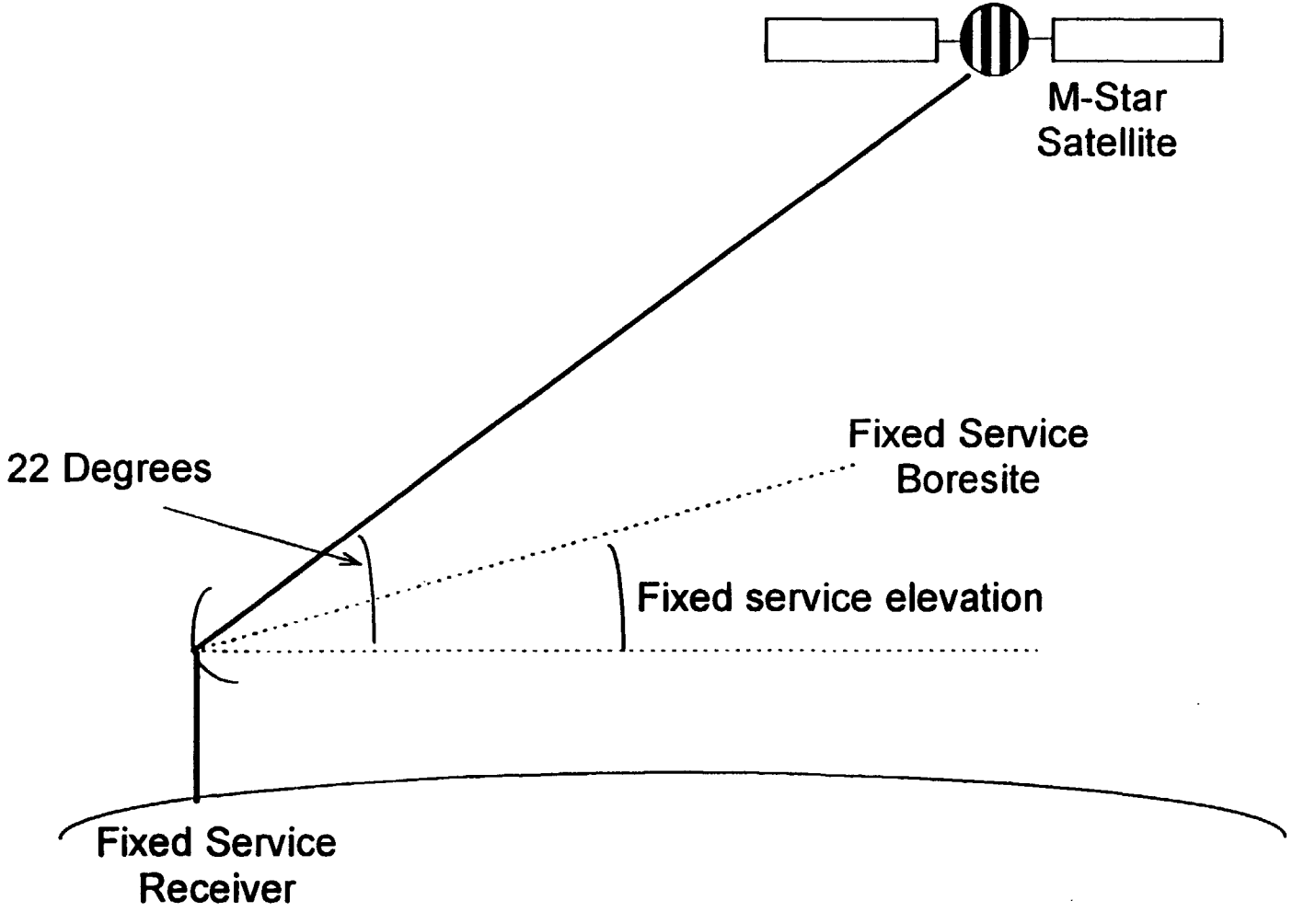
Xmit Antenna 1.5 m 46.2 to 79.5 W

Rx Antenna G/T=26.4 dB/K

# Sharing with Fixed Service

- **M-Star into Fixed Service**
  - ⇒ **37.5 - 40.5 GHz band (Sharing with Satellites).**
  - ⇒ **47.2 - 50.2 GHz band (Sharing with Earth Stations).**
- **Fixed Service interference into M-Star**
  - ⇒ **37.5 - 40.5 GHz band (Sharing with Earth Stations).**
  - ⇒ **47.2 - 50.2 GHz band (Sharing with Satellites).**

# Geometry of M-Star Downlink into Fixed Service at 40 GHz



# M-Star Satellites into FS (37.5 - 40.5 GHz)

- M-Star is below 47 CFR 25.208(c) PFD limits
- Downlink calculations show that the peak Io/No interference level experienced by the Fixed Service is -14.2 dB.
- M-Star downlink can share without coordination.

# Analysis Details of M-Star Downlink into Fixed Service at 40 GHz

## PEAK IMPACT OF M-STAR DOWNLINK

| | Cell Site | OC-1 (MTSO) | OC-1 (Server) |
|---|---|---|---|
| FS Elevation Angle (deg) | Io/No (dB) | Io/No (dB) | Io/No (dB) |
| 0 | -44.9 | -40.2 | -42.7 |
| 5 | -42.1 | -37.4 | -39.9 |
| 10 | -38.4 | -33.6 | -36.1 |
| 15 | -32.5 | -27.8 | -30.3 |
| 20 | -18.9 | -14.2 | -16.7 |

## M-STAR TRANSMITTER PARAMETERS (Cell Site)

| | | |
|---|---|---|
| Power Radiated | W | 0.02 |
| Output losses | dB | 1.50 |
| Carrier frequency | GHz | 40 |
| Information rate | Mbps | 10.24 |
| Pwr spectral density | dBW/Hz | -88.59 |
| Antenna boresite gain | dBi | 40.60 |
| Off boresite angle | deg | 0 |
| Off boresite gain | dBi | 40.60 |
| EIRP (boresite) | dBW | 22.11 |
| EIRPSD (off boresite) | dBW/Hz | -47.99 |

## CHANNEL PARAMETERS

| | | |
|---|---|---|
| Distance | km | 2585.9 |
| Total absorbtion | dB | 1.80 |
| Spreading loss | dB | 192.74 |

## FS RECEIVER PARAMETERS

| | | |
|---|---|---|
| System temperature | K | 1000 |
| No | dBW/Hz | -198.60 |
| Off boresite angle | degrees | 2 |
| Antenna diameter | m | 0.66 |
| Antenna boresite gain | dBi | 46.60 |
| Off boresight gain | dBi | 25.03 |
| Io | dBW/Hz | -217.50 |
| Io/No | dB | -18.90 |

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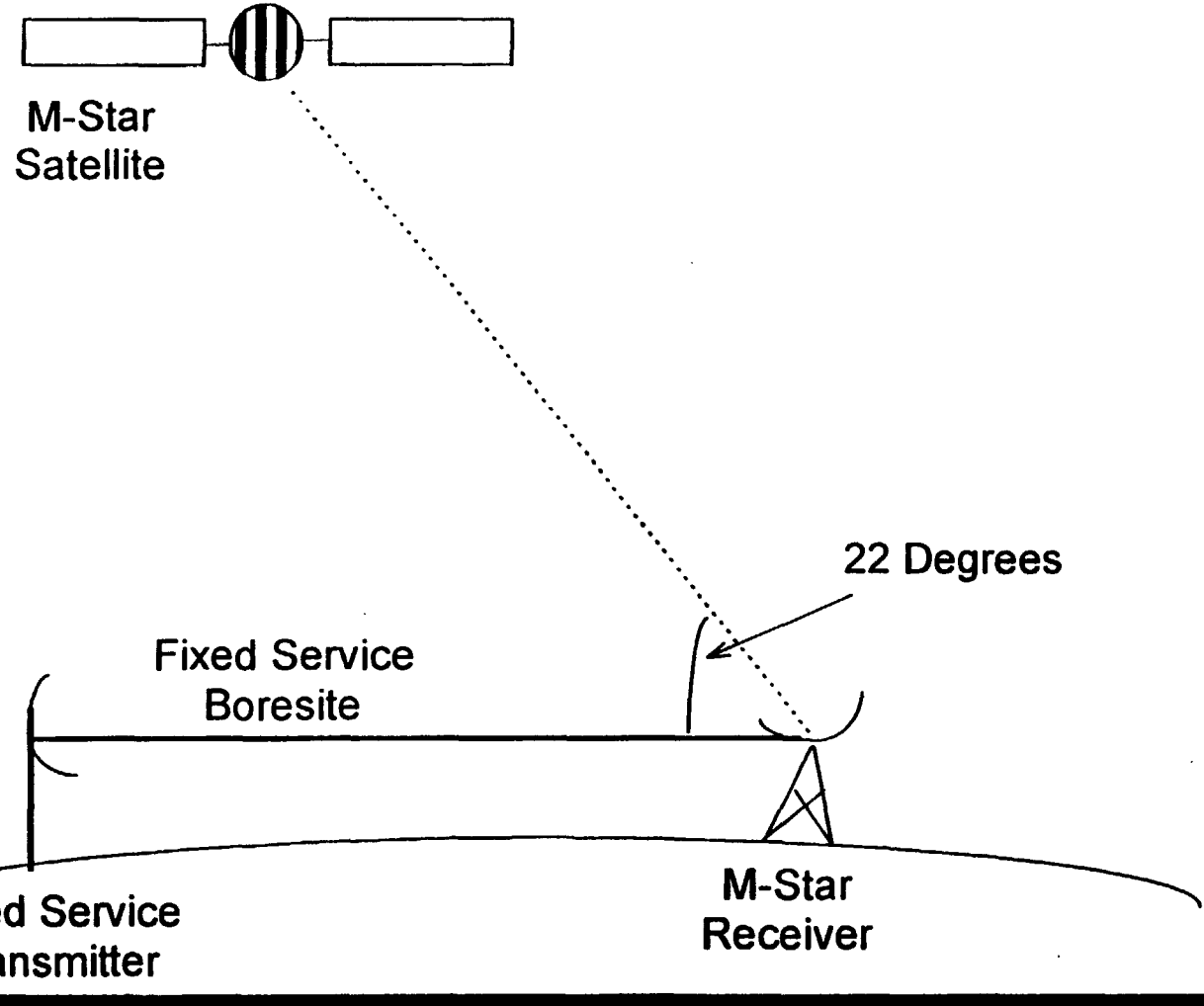
**Geometry of Fixed Service into M-Star Downlink at 40 GHz**



# FS into M-Star Earth Stations (37.5 - 40.5 GHz)

- M-Star will accept interference from the Fixed Service located 1 km away at the level of Io/No = -13 dB.
- Sharing Rules:

  EIRP Limits:

  For Fixed Service transmitters with clear air EIRP density less than -28.4 dBW/MHz no coordination required. Fixed Service can exceed this limit by means of adaptive power control only to the extent where link propagation attenuation exceeds the clear air value due to precipitation.

  Higher power terminals need to be coordinated.

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**Analysis Details of Fixed Service into M-Star Downlink at 40 GHz**

# BizTel Inc.
# (File No.: 4228-CF-P/L-24)

**FS RECEIVER**

| | | | | |
|---|---|---|---|---|
| Receiver Noise Temp | deg | 1000 | | |
| No | dBW/Hz | | -198.60 | |
| Reqd Co/No | dB | | 8.00 | |
| Margin | dB | | 6.00 | |
| Rx antenna gain | dBi | | 46.59 | |
| Max tx EIRP | W | 0.05 | dbW | -13.01 |
| Channel NBW | MHz | 5 | | |
| | MHz | 20 | | |

**FS CHANNEL**

| | | | 5 MHz Channel | | 20 MHz Channel |
|---|---|---|---|---|---|
| Frequency | GHz | 40 | | | |
| Tx-Rx distance | km | 7.36 | | 7.36 | |
| Spreading loss | dB | | 141.82 | | 141.82 |
| Atmos. Absorption | dB/km | 0.13 | 0.96 | | 0.96 |
| Total propagation loss | dB | | 142.77 | | 142.77 |

**FS TRANSMITTER**

| | | | | | |
|---|---|---|---|---|---|
| Reqd EIRP dens | dBW/Hz | | -88.42 | | -88.42 |
| Reqd EIRP | dBW/channel | | -21.43 | | -15.41 |
| Tx antenna gain | dBi | | 46.59 | | 46.59 |
| Reqd Power dens | dBW/Hz | | -135.01 | | -135.01 |

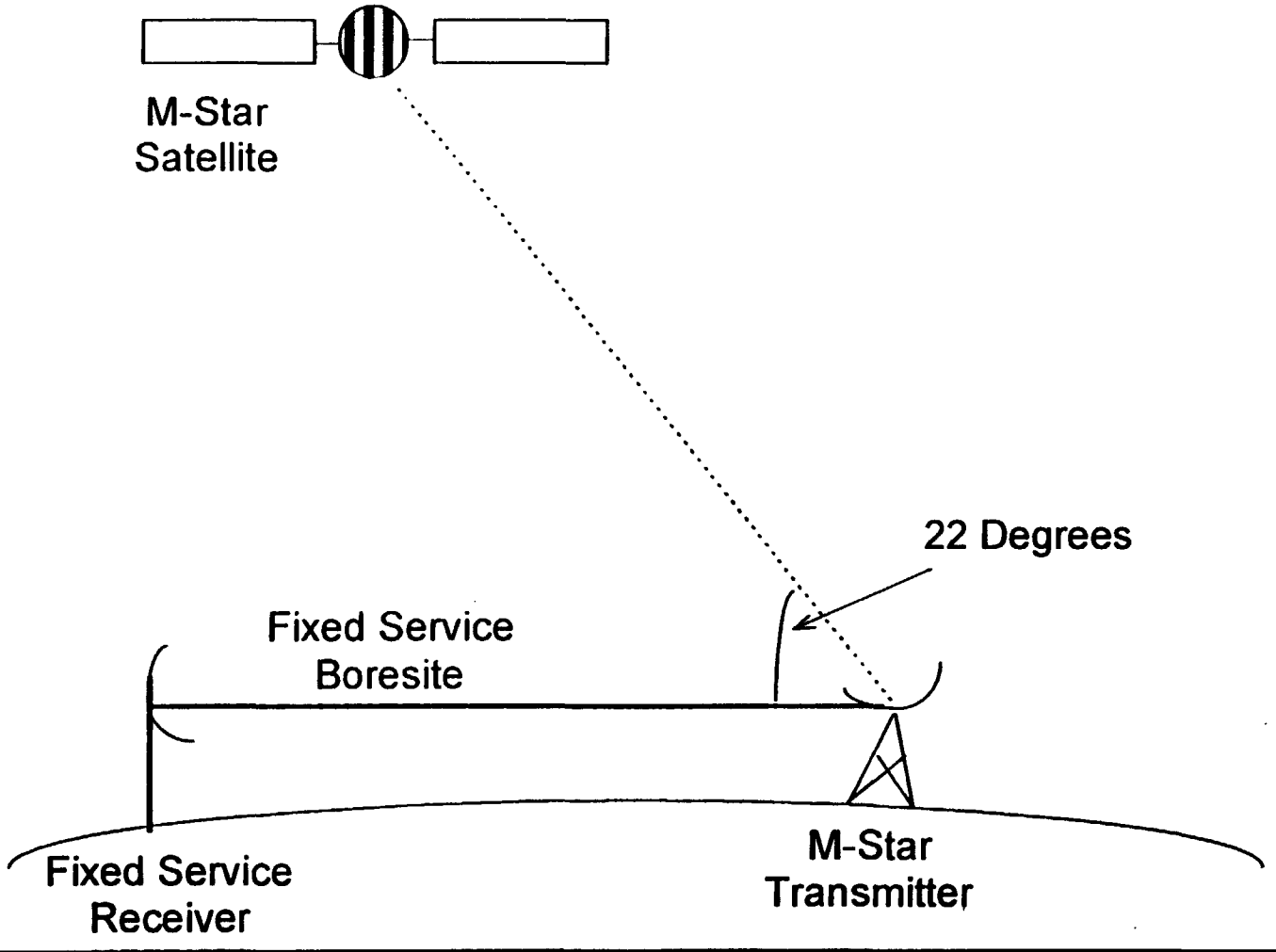
**FSS CHANNEL**

| | | | 5 MHz Channel | 20 MHz Channel |
|---|---|---|---|---|
| Tx-Rx distance | km | 1 | | |
| Spreading loss | dB | | 124.48 | 124.48 |
| Atmos. Absorption | dB/km | 0.13 | 0.13 | 0.13 |
| Total path loss | dB | | 124.61 | 124.61 |

**FSS RECEIVER**

| | | | | |
|---|---|---|---|---|
| Rec. Noise Temp. | K | 503 | | |
| No | dBW/Hz | | -201.58 | -201.58 |
| Rx antenna gain | dBi | | -1.56 | -1.56 |
| Io | dBW/Hz | | -214.59 | -214.59 |
| Io/No | dB | | -13.01 | -13.01 |

# Geometry of M-Star Earth Station into Fixed Service at 50 GHz



# M-Star Earth Stations into FS (47.2 - 50.2 GHz)

- M-Star is below EIRP limits of 47 CFR 25.204(b)
- Maximum required separation distance for Io/No to be below -13 dB (5% rise in noise floor) is 69.2 km for Fixed Service main beam interactions.
- Coordination with Fixed Service will be required.

**SEPARATION DISTANCE OF M-STAR UPLINK TO ACHIEVE Io/No = -13 dB**

| FS Azimuth Angle (deg) | Cell Site Distance (km) | OC-1 (MTSO) Distance (km) | OC-1 (Server) Distance (km) |
|---|---|---|---|
| 0 | 67.0 | 59.5 | 69.2 |
| 2.5 | 23.0 | 18.1 | 24.5 |
| 5 | 14.4 | 10.7 | 15.5 |
| 10 | 8.1 | 5.7 | 8.9 |
| 45 | 1.7 | 1.1 | 1.9 |

**M-STAR TRANSMITTER PARAMETERS (Cell Site)**

| | | |
|---|---|---|
| Power Radiated | W | 1.5 |
| Output losses | dB | 0.50 |
| Carrier frequency | GHz | 50 |
| Information rate | Mbps | 10.24 |
| Pwr spectral density | dBW/Hz | -68.84 |
| Antenna boresite gain | dBi | 49.30 |
| Off boresite angle | deg | 22 |
| Off boresite gain | dBi | -1.56 |
| EIRP (boresite) | dBW | 50.56 |
| EIRPSD (off boresite) | dBW/Hz | -70.40 |

**CHANNEL PARAMETERS**

| | | |
|---|---|---|
| Distance | km | 67.00 |
| Total absorbtion (0.4 dB/km) | dB | 26.80 |
| Spreading loss | dB | 162.94 |

**FS RECEIVER PARAMETERS**

| | | |
|---|---|---|
| System temperature | K | 1000 |
| No | dBW/Hz | -198.60 |
| Off boresite angle | degrees | 0 |
| Antenna diameter | m | 0.66 |
| Antenna boresite gain | dBi | 48.53 |
| Off boresight gain | dBi | 48.53 |
| Io | dBW/Hz | -211.61 |
| Io/No | dB | -13.01 |

# Geometry of Fixed Service into M-Star Uplink at 50 GHz